



Exploring the structure-properties relationships of novel polyamide thin film composite membranes

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INTRODUCTION

Polysulfone (PSU) is a material widely used in the fabrication of membranes for ultrafiltration and as a support for nanofiltration and reverse osmosis membranes. Interfacial polymerization usually combines amine and acid chloride monomers for the fabrication of thin film composite membranes[1]. However, only few publications describe its usage for the modification of supports for the fabrication of ultrafiltration membranes [2]. This research focuses on the modification of PSU supports to produce new ultrafiltration membranes.

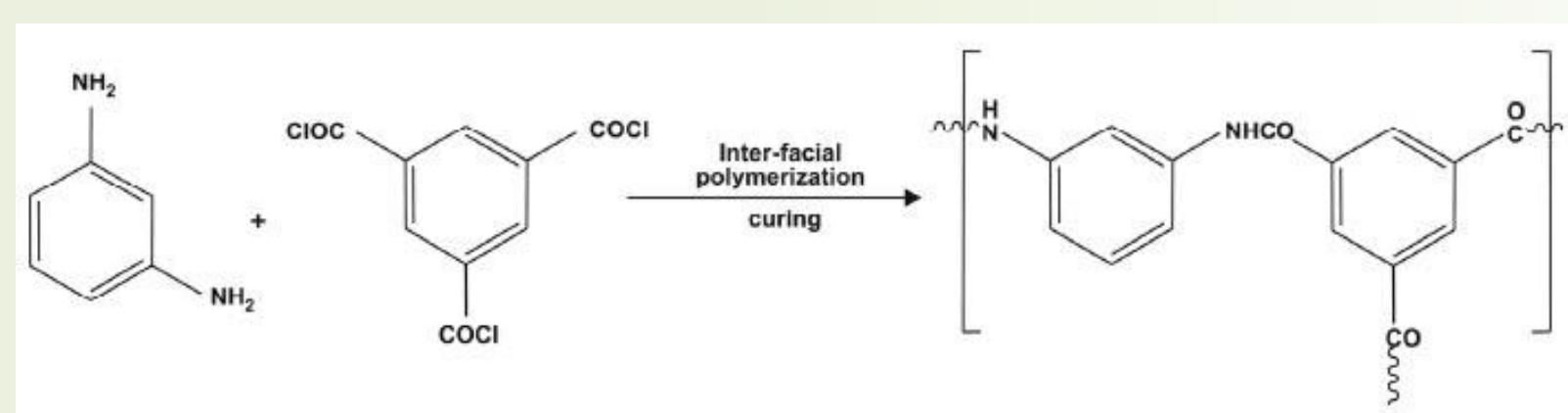


Fig 1. Interfacial polymerization of 1,3-phenylene diamine and 1,3,5-trimesoyl chloride

The advantages of interfacial polymerization in the fabrication of UF membranes includes:

- Negatively charged PSF surfaces that could be less prone to biofouling
- Scale up process for the modification of PSU. An alternative to costly and technically challenging processes as *in situ* interfacial polymerization [3].

THE MAIN CHALLENGE AND OBJECTIVE

- Determine the best amine and acid chloride combination to produce a defect free membranes accordingly to a fabrication procedure easy to scale up in the production line.
- Avoid traditional methods used in lab scale membrane fabrication in order to produce defect free membranes. It implies; analysis of support, type of monomers, concentration, reaction time and type of solvent [2]

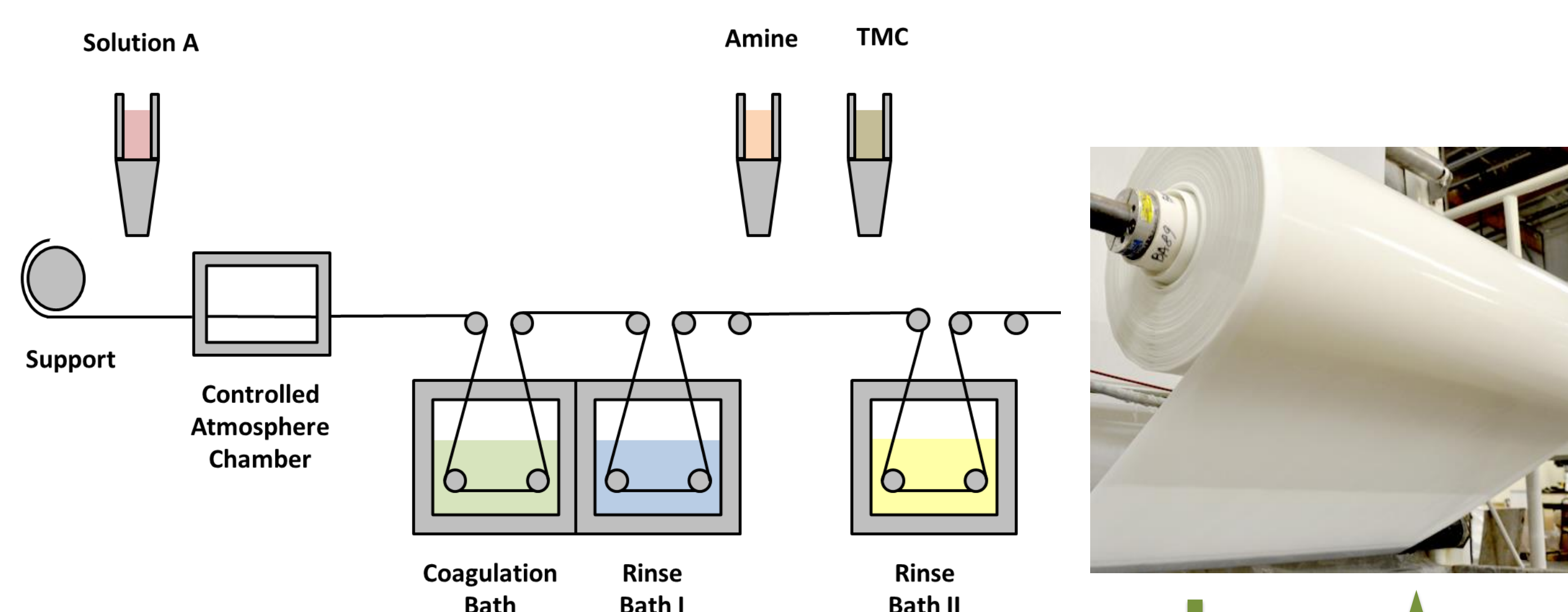


Fig 2. Industrial process for the fabrication of membranes by interfacial polymerization

- The membranes must be produced at lab scale emulating the fabrication in large scale.
- It is important to achieve a proper optimization of variables to reproduce defect free membranes at lab scale



Fig 3. The presence of defects is verified with Rhodamine B

CONCLUSIONS

- After screening different amine combinations it was possible to coat Polysulfone supports to produce membranes in the range of nanofiltration and ultrafiltration under interfacial polymerization conditions.
- Further optimization of the fabrication procedure is required to enhance water flux and improve antifouling properties in the ultrafiltration range.

THE METHOD

- More than 15 types of recipes have been tested in order to fabricate membranes with different fluxes.
- The membranes were fabricated in lab scale. Only immersion of the membrane film in different baths (no drain of excess solution [1], no roller, air knife or oven) was used as intermediate steps/ tools
- Water flux was measured at 15.5 bar. The test membrane area was $4.5 \cdot 10^{-3} \text{ m}^2$

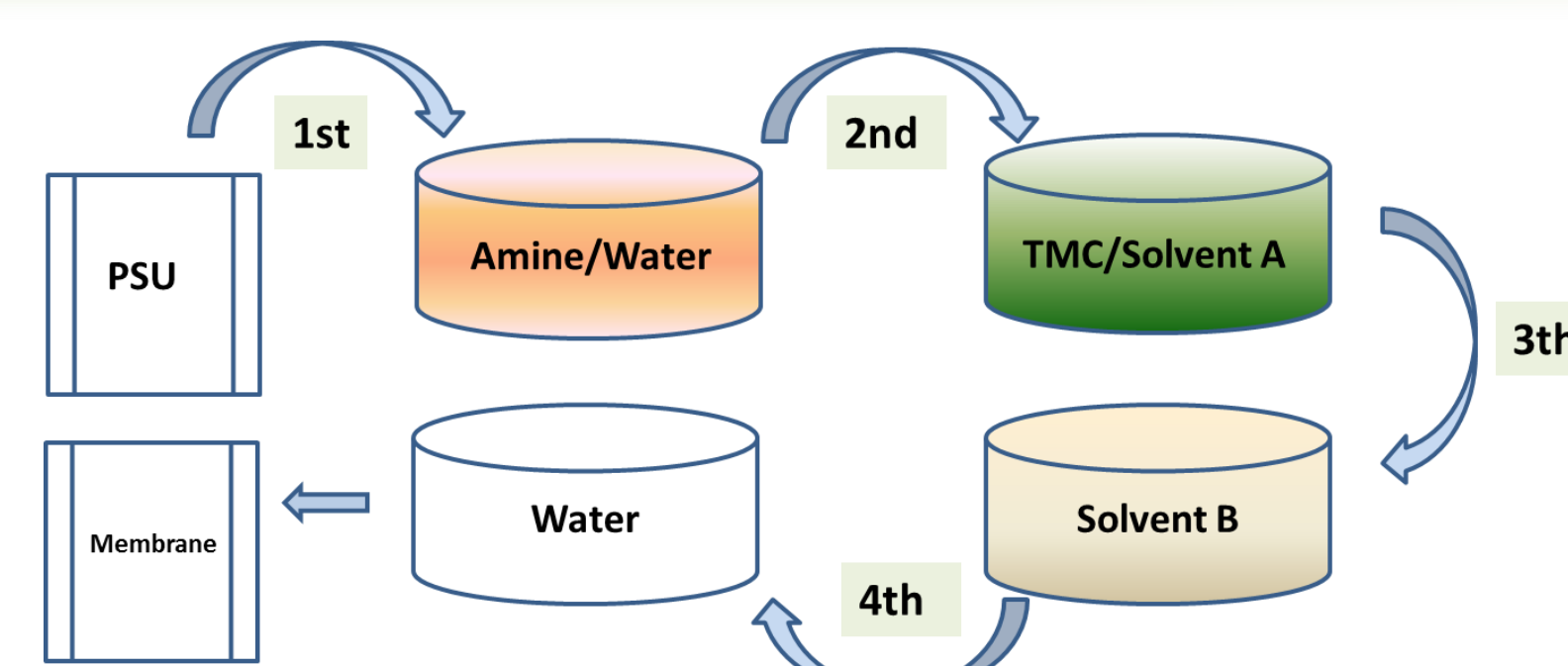


Fig 4. Fabrication method of thin film composite membranes

THE RESULTS

WATER FLUX OF DEFECT FREE MEMBRANES

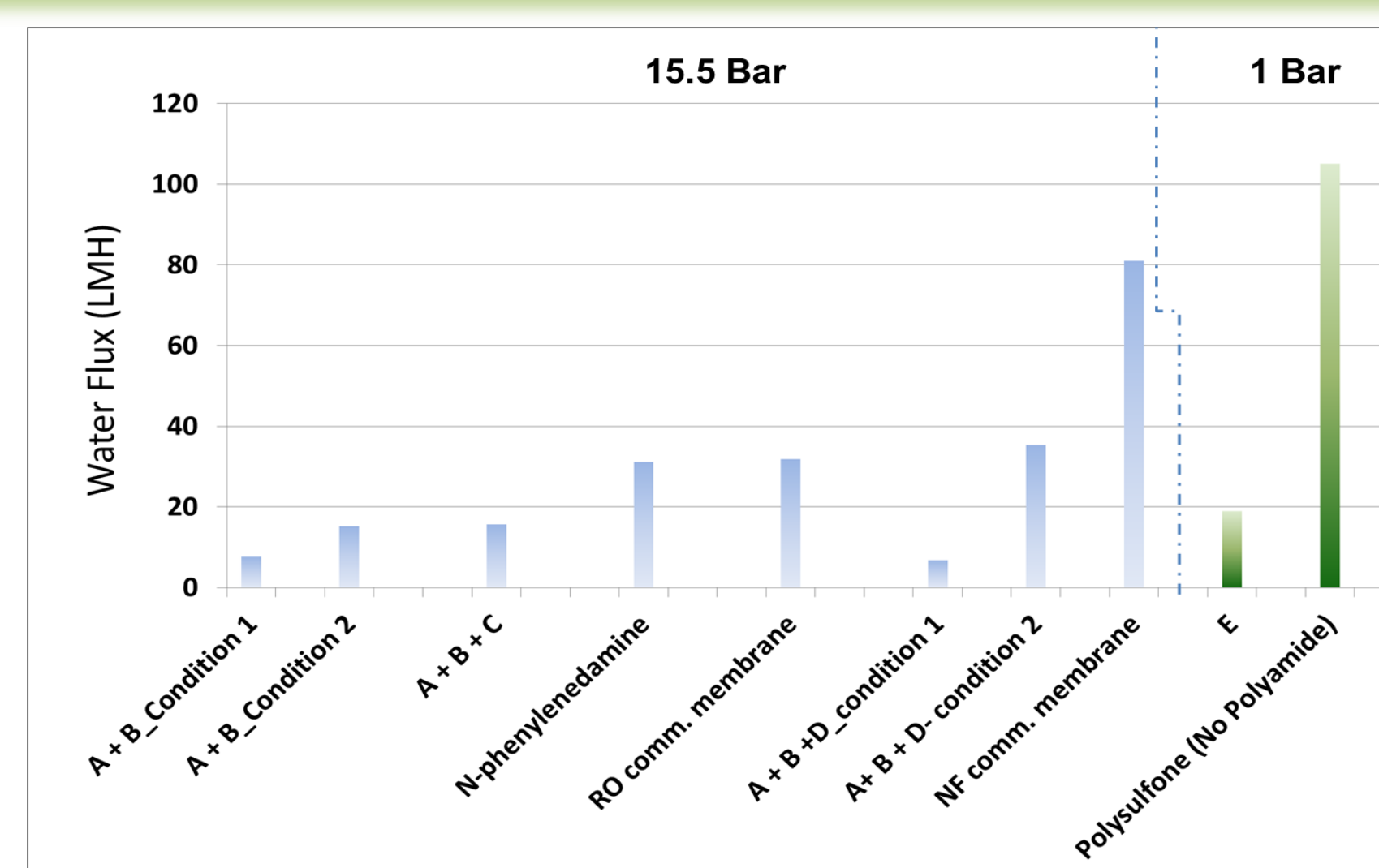


Fig 5. Water flux of different membrane recipes

Different combinations of monomers and fabrication variables produce different type of membranes. However, only a few recipes produced defect free membranes

MEMBRANE CHARACTERIZATION

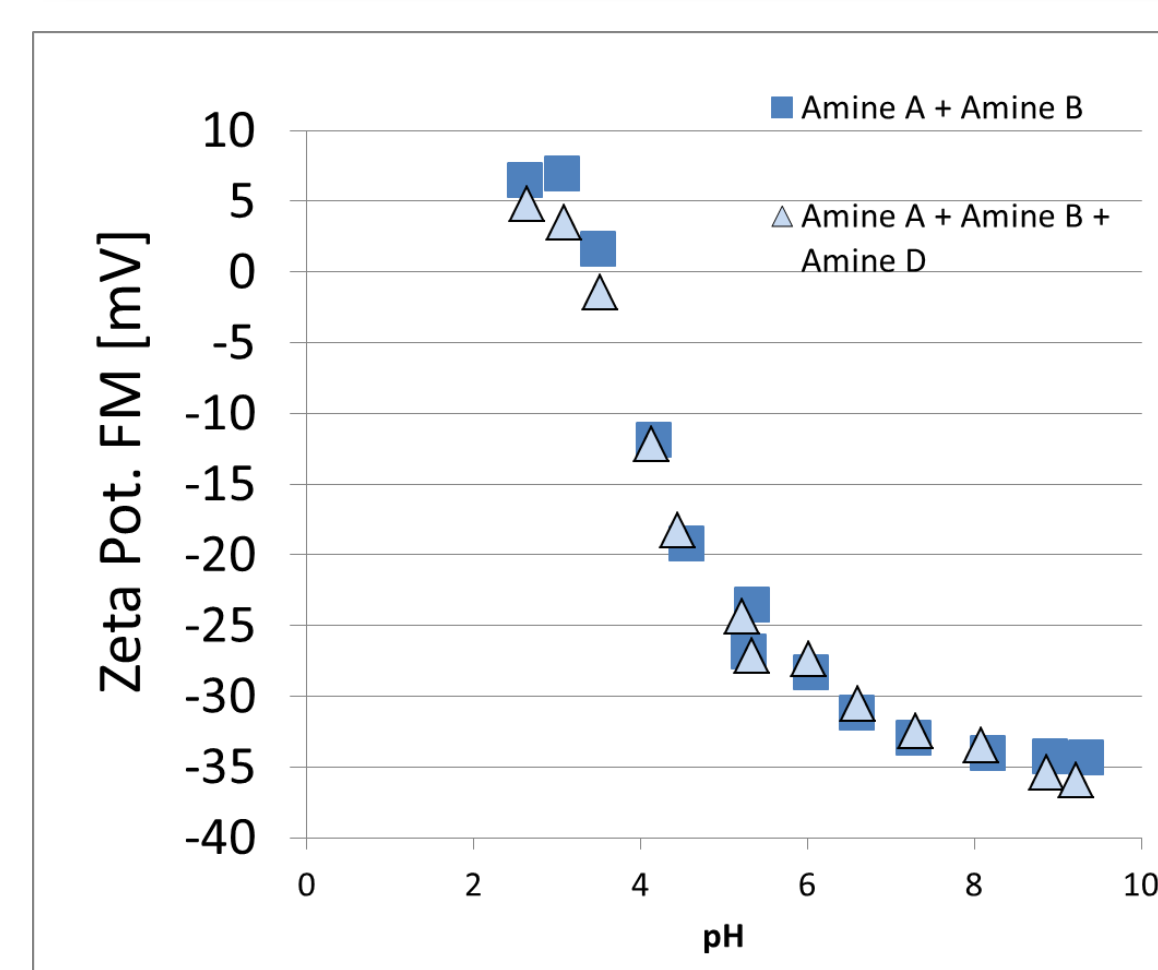


Fig 6. Zeta potential of 2 different recipes (10mM M NaCl)

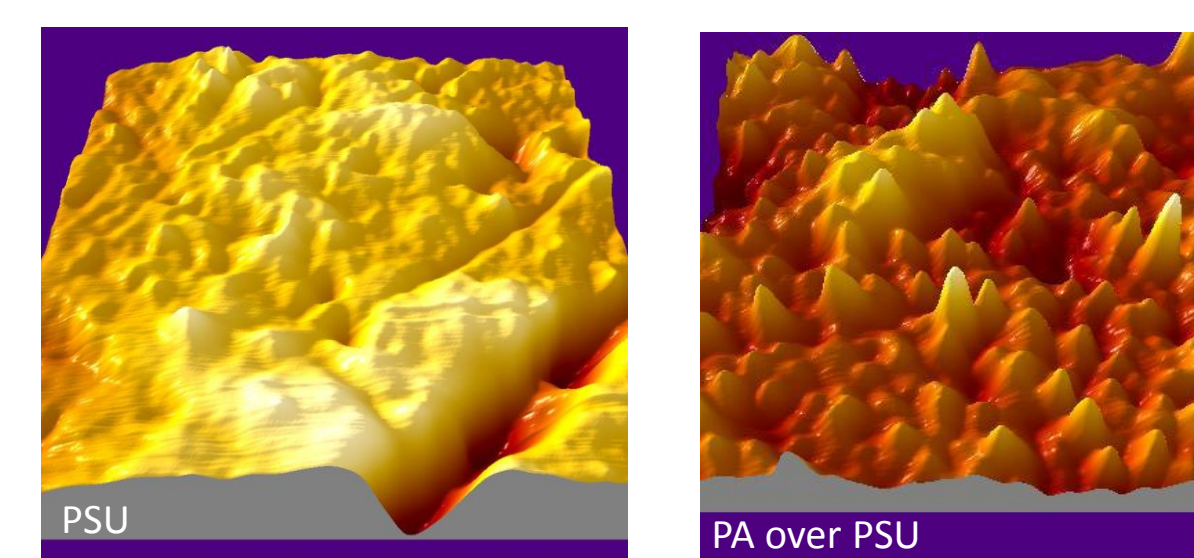


Fig 7. AFM images (3D) of PSF before and after coating with polyamide. Defect free membrane

Defect free membranes were achieved after parameter optimization. The high negative potential indicates a network structure with COOH pendant group.

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ACKNOWLEDGEMENTS

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